Nanoparticles in medicine

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Nanoparticles are being applied in diverse ways in medicine In virtually all applications they are so constructed as to selectively associate with a specific cell type or cell surface ligand or small molecule or protein or oligonucleotide. From that point their characteristics diverge depending on their function. Analytical (ex vivo) diagnostics employ gold and silver and semiconductor quantum dots. Their properties are optimized for multiplexing at very high levels of selectivity and sensitivity down to attomolar concentrations. In vivo applications couple the selective recognition aspect of a diagnostic tool to the imaging and/or the therapeutic power to the nanoparticle. That therapeutic power can be to deliver a drug or to be itself the therapeutic agent by delivering a lethal dose of radiation or interacting with externally applied focussed ultrasound or magnetic fields to heat the immediate surroundings and induce hyperthermic cell death.

This lecture will treat various examples of these applications of nanoparticles.

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Parameters of nanoparticles determining distribution and accumulation in secondary target organs

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Nanoparticles are increasingly used in a wide range of applications in science, technology and medicine. Since they are produced for specific purposes which cannot be met by larger particles and bulk material they are likely to be highly reactive, in particular, with biological systems.

There is clear evidence that nanoparticles can cross body membranes and reach and accumulate in secondary target organs like heart, liver, spleen, brain and reproductive organs and foetus eventually causing adverse effects on cardiac function and blood coagulation.

To quantitatively determine accumulated fractions in such organs the ultimate aim is to quantitatively balance the fractions of nanoparticles in all interesting organs and tissues of the body including the remainder body and total excretion collected between application and autopsy. Substantial uncertainty will remain if only selected organs are analyzed. Since these gross determinations of nanoparticle contents in organs and tissues do not provide microscopic information on the anatomical and cellular location of nanoparticles such studies are recommended to be complemented by electron microscopy analysis.

In addition, the role of particle parameters determining this translocation dynamics remains to be not fully understood. Nanoparticle parameters such as size, surface charge, and surface ligands. The current knowledge on systemic translocation of ultrafine particles in man and animal models and an estimate of accumulating particle number, surface area and mass in secondary target organs during short-term and chronic exposure will be discussed in order to demonstrate the relevance of translocated fractions of nanoparticles.

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Nanomaterials: Ensuring their safety

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Nanotechnologies should find applications in almost any imaginable domain because of their expected benefits. Yet, some exhibit potential risks. In the event, products of nanotechnologies now have entered the market by the hundreds. Their further development and market uptake depend on citizens' safety, trust, and acceptance. The European Union gave itself an Action Plan to ensure the "safe, integrated, and responsible development of nanotechnologies". The presentation will review progress made on the European Action Plan and, in particular, provide an update on the work of the independent Scientific Committees, which, through their Scientific Opinion, play a key role in informing Community policy making.

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Carbon nanotubes and their influence on cell viability and function